

Nanotechnology and Cyberinfrastructure: The nanoHUB Experience

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Nanotechnology is projected to have a profound impact across a broad range of industries. Over the past decade, the advances in nanoscience have been stunning. Promising ideas for turning this emerging science into real technologies are beginning to emerge. Many such exciting advances will be reported at this conference. Computational science and engineering play an important role in the development of emerging fields such as nanotechnology. Computers, networks, visualization, and massive data storage are no longer new, but years of exponential growth in their capabilities and their fusion into integrated systems is leading to something fundamentally new that is now known as cyberinfrastructure. Cyberinfrastructure is beginning to transform the conduct of research and education. Where this is all heading is still not clear, but it seems very likely that new kinds of cyberinfrastructure will change the way research is conducted, how learning occurs, and how a university engages the global community. The Network for Computational Nanotechnology (NCN) is an NSF-funded initiative designed to connect computational experts to experimentalists, designers, and educators who make use of simulation. The nanoHUB, a science gateway developed by the NCN, has become a major example of the impact that cyberinfrastructure can have in research, education, and outreach. My purpose in this presentation is to tell the nanoHUB story as an example of how cyberinfrastructure supports and enables research and education.

The Network for Computational Nanotechnology (www.ncn.purdue.edu) is a six-university initiative that was established in 2002 to connect those who develop simulation tools with those who use them. The NCN currently addresses nanoelectronics, NEMS, nanofluidics, devices for nanomedicine, and nanophotonics. The NCN's strategy centers on a unique, science gateway, www.nanoHUB.org offering online simulation services for research, education, and collaboration and a new way to publish research and instructional materials. At the nanoHUB website, users log on, access state-of-the-art simulation software, run interactive graphical or batch simulations, and view the results online. There is no need to download, install, support, or maintain sophisticated software or to worry about accounts or how to access specific machines. Tremendous computing resources are provided freely and transparently. The nanoHUB is also a resource for cross-disciplinary education by hosting online tutorials, short courses, and full courses. It also hosts tools for collaborating on research, education, and software development. Over 60,000 people make use of the nanoHUB each year; about one-half of the nanoHUB users are outside of the US. In this presentation, I will describe the nanoHUB and how it supports research, education, and collaboration. I will encourage the audience to make use of the nanoHUB and to contribute to its growing resource base. Finally, I will speculate on how cyberinfrastructure of this kind will affect us all in universities, industry, and government.

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Mark Lundstrom is the Don and Carol Scifres Distinguished Professor of Electrical and Computer Engineering at Purdue University and the founding director of the National Science Foundation's Network for Computational Nanotechnology (NCN). He earned his bachelor's and master's degrees from the University of Minnesota in 1973 and 1974, respectively and joined the Purdue faculty upon completing his doctorate on the West Lafayette campus in 1980. Before attending Purdue, he worked at Hewlett-Packard Corporation on integrated circuit process development and manufacturing.

Lundstrom's research interests include electronic devices, carrier transport, and computer simulation with an emphasis on nanoelectronic devices. In the 1990's, Lundstrom co-founded (with his colleagues, Nirav Kapadia and José Fortes, the PUNCH project, which provided online simulation services for research and education in micro and nanoelectronics. That work led to the NCN, which now provides the global nanotechnology community with services for online simulation, education, and collaboration. In addition to his research, Lundstrom is spearheading the "Electronics from the Bottom Up" initiative with his colleagues at Purdue University. He is a fellow of the Institute of Electrical and Electronic Engineers (IEEE), the American Physical Society, and the American Association for the Advancement of Science (AAAS). He is the recipient of several awards for his teaching and research, most recently Semiconductor Industry Association's 2005 University Researcher Award for his career contributions to the semiconductor industry and the 2006 inaugural Education Award from the IEEE Electron Devices Society.